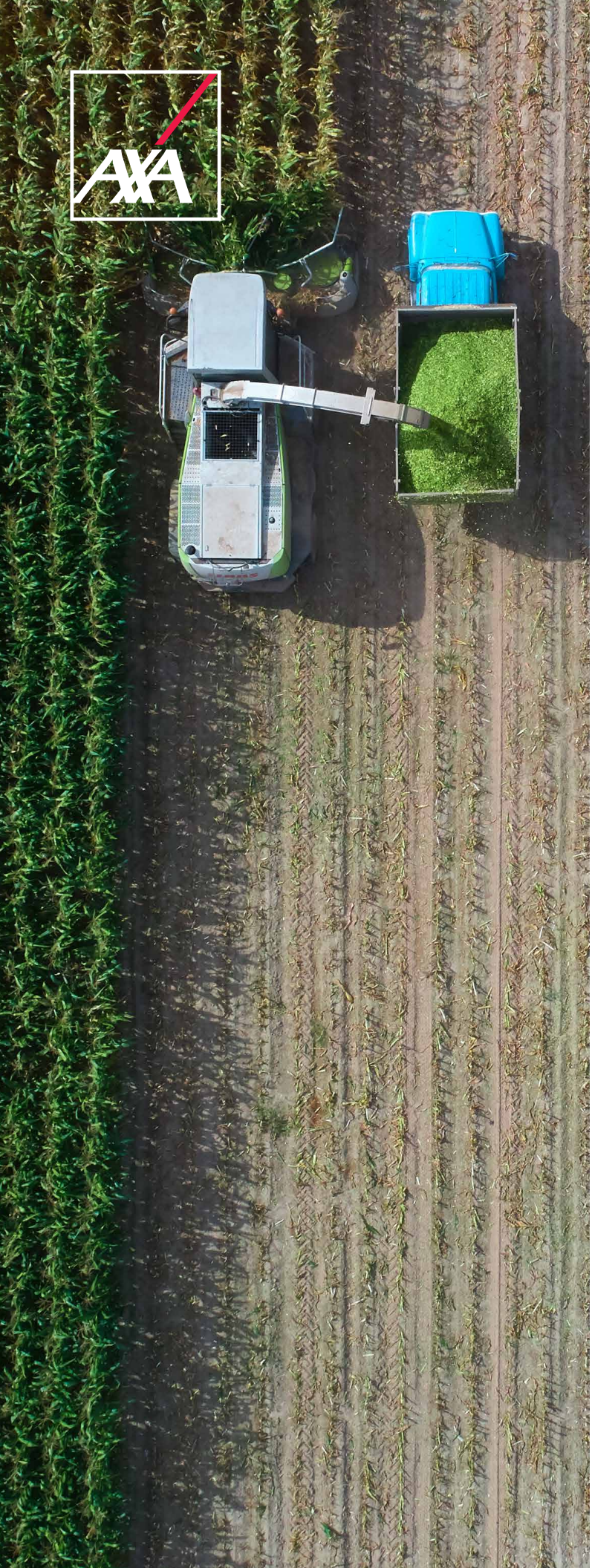

Product Innovation: Index Insurance

In the agricultural risk transfer world, the concept of index insurance is well-established, and has been around for several decades. It aims to simplify the insurer to customer chain by triggering a payout based on an objective proxy for loss. Although simplifying the more traditional insurance chain by removing the cost of potentially complex claims processes, the proxy and trigger system introduces “basis risk” into the insurance product.

Basis risk can be described simply as a mismatch between the amount of payout and the value of the actual loss suffered by an insured. Basis risk is a key reason for the limitation of index insurance to:

- certain classes of business in which the proxy shows a good relationship with loss, or
- locations in which the cost of the traditional claims process makes traditional insurance products prohibitively expensive.

During recent decades, the data associated with a wide range of different remote sensing (i.e. satellite data and associated rainfall, vegetation) and agroclimatic variables (potential evapotranspiration, water-balance, soil moisture) have been made freely available to the public. This increased data availability can help to offer farmers better protection against extreme weather. To achieve this, data underlying parametric insurance schemes should be carefully selected and/or combined taking local contexts and data uncertainty into account. Eventually, the resulting index should be well-validated[1].

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By Niklaus Lehmann, Beat Krauer and Willemijn Vroege

Novel Parametric Insurance Scheme at the Meso-Level in Nicaragua

AXA XL's Global Agriculture team along with Incofin Investment Management[2] and two local Nicaraguan insurance companies have developed a novel parametric insurance program for smallholder farmers in Nicaragua. Launched in 2017, in collaboration with three Nicaraguan microfinance institutions (MFIs), this program helps protect 10,000 coffee and grain farmers, more than 90 percent of whom possess fewer than 10 hectares of land. The scheme covers both excessive rainfall and prolonged drought.

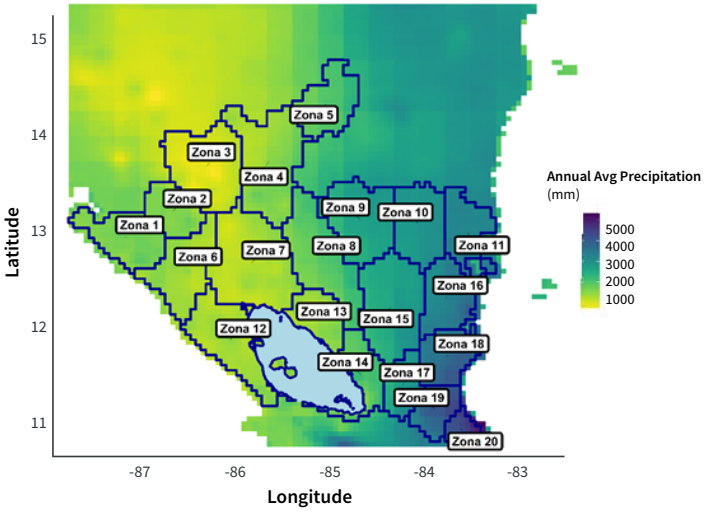
In places like Nicaragua that contain many different microclimates and where farmers grow a variety of crops, basis risk is magnified. For example, coffee is grown in mountainous districts that are cool and wet, while grain farms occupy the warmer, drier coastal areas. A single index for the entire country, or even four or five indices covering different regions and crops, would have led to considerable basis risk.

Here basis risk was minimized by splitting the country into twenty units based on their similar climate conditions (see Figure 1). In addition, specific indices were developed for all crop types included in the MFIs' insurance portfolios. Although that meant creating separate models for each zone and crop, the index values derived from these individual models are highly correlated with outcomes in these smaller, more homogeneous areas thereby reducing potential basis risk.

Another critical consideration when designing parametric programs for each zone was where to set the thresholds when payouts are triggered. Lower threshold levels provide protection for more frequent events and typically are more expensive. Conversely, higher thresholds protect against less common threats and often are relatively less costly. After extensive discussions with the MFIs and a survey of three thousand smallholder farmers, we set the threshold levels for both excess of rain and drought events to cover not only catastrophes but also what we characterize as medium-magnitude events. For excessive precipitation, payouts are triggered even when the rainfall totals are only about 50% above average; for drought, payments are made when the lack of rain is only slightly below average values. Basing the thresholds on more frequent but still destructive medium-magnitude events has proven to be quite effective in fostering greater resilience and stability in rural parts of Nicaragua. Historical analysis indicates that the resilience of a community won't necessarily deteriorate markedly after medium-magnitude weather events. That's evidently because many farmers avoid defaulting on their loans by selling capital assets or taking out second loans. The downside is that the impact of the next damaging event is amplified because farmers are in more precarious states due to ramifications from the previous event.

> The increased availability of remote sensing and ancillary data sets can help to offer farmers better protection against extreme weather.

Figure 1: Homogenous climate zones in Nicaragua



One of the as-yet-unanswered questions about programs like this is what effect they could have in boosting confidence among MFIs to invest in the challenging agricultural sector. A related issue is whether the increased protection that parametric-based coverages deliver will help attract additional private investment in areas that are now more economically stable and secure.

A further example of potential for index-based insurance relates to work we have been doing looking at grasslands insurance (Vroege et al., 2019)[3]. Grasslands make up the biggest part of the world's agricultural area. Even though a farm's grassland production can vary substantially from one year to another, the global penetration of insurance for grassland systems is low.

Continued ➲

AXA XL Reinsurance's Global Agriculture team has evaluated the effectiveness of a wide range of different weather and remote sensing variables as proxy for grassland productivity. Table 1 shows the correlation between grassland productivity and a selection of agroclimatic and vegetation indices at the municipality level for Switzerland. First of all, it should be pointed out that for all indices, correlation coefficients are only moderately strong mainly because only qualitative estimations were available for the grassland productivity[4]. Notwithstanding these limitations, our analysis clearly shows that the water balance[5] and the fCover significantly outperform precipitation as a proxy variable for grassland productivity. In particular, fCover, which corresponds to the fraction of ground covered by green vegetation measured by satellites from space, has a high potential as an index variable for grassland productivity. This finding is very much aligned with scientific literature demonstrating the high suitability of fCover as an index proxy for parametric grassland insurances (Roumiguié et al., 2015)[6].

Table 1: Correlation between selected Indices and Grassland Productivity in Switzerland

Index Variable	Correlation
Precipitation	0.42
Potential Evapotranspiration	-0.46
Water Balance	0.44
fPAR	0.33
fCover	0.52
Dry Matter	-0.18
NDVI	0.38

In order to cross check our findings in other geographies, we conducted the same kind of analysis in France and Manitoba (Canada). While the lack of granular grassland productivity data didn't allow us to perform the evaluation at the same depth, the general results obtained for France and Manitoba are very much in line with our findings in Switzerland. Even though, climatic growing conditions vary substantially across the countries, in all geographies fCover proved to be a very suitable proxy in measuring the productivity of grasslands.

These two examples indicate the progress that we continue to make regarding the use of parametric insurance as an additional tool to address some of the growing risks we face as an industry. Shifting our analysis away from focusing purely on the hazard towards understanding what drives the loss allows us to create more meaningful indices, reducing basis risk and creating more affordable and sustainable insurance products.

References:

1 Vroege, W., Vrieling, A. and Finger, R., Satellite support to insure farmers against extreme droughts, Nature Food, March 2021, DOI :10.1038/s43016-021-00244-6
2 Incofin Investment Management is an impact investor with a history of investing in financial institutions and the agricultural sector in emerging markets.
3 Vroege, T. Dalhaus, R. Finger, Index insurances for grasslands – A review for Europe and North America, *Agricultural Systems*, Volume 168, January 2019, pp. 101-111
4 Qualitative grassland productivity data was converted using a standardization approach into quantitative variables.
5 The Water Balance is defined as the daily difference between precipitation and the potential evapotranspiration.
6 A. Roumiguié, A. Jacquin, G. Sigel, H. Poilvé, B. Lepoivre, O. Hagolle, Development of an index-based insurance product: validation of a forage production index derived from medium spatial resolution fCover time series, *GIScience Remote Sens.*, 52 (2015), pp. 94-113W.

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